

**Redescription of *Ornithostrongylus fariai* Travassos, 1914, type species of the genus *Ornithostrongylus* Travassos, 1914, and of *O. salobrensis* Travassos, 1941 (Nematoda, Trichostrongylina, Heligmosomoidea), both parasites of Columbidae from Paraguay**

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**Redescription of *Ornithostrongylus fariai* Travassos, 1914, type species of the genus *Ornithostrongylus* Travassos, 1914, and of *O. salobrensis* Travassos, 1941 (Nematoda, Trichostrongylina, Heligmosomoidea), both parasites of Columbidae from Paraguay.** - *O. fariai* Travassos, 1914, type species of the genus *Ornithostrongylus* and *O. salobrensis* Travassos, 1941, described from *Leptoptila* spp. in Brazil, are redescribed on the basis of specimens collected in *Leptoptila verreauxi* caught in Paraguay. The synlophe has a variable pattern in the anterior part of the body in both sexes and in the posterior part of the female body. Lateral alae are present along the anterior third of the body in *O. fariai* and in the anterior quarter in *O. salobrensis*. In *O. fariai*, the number of cuticular ridges is 14 from the middle of the body to the posterior end. In *O. salobrensis*, the number of ridges is 14 in the middle of the body in the male and 10 in the female; in the posterior quarter of the body, the male has 8 ridges and the female lacks ridges behind the vulva.

**Keywords:** Nematoda - Heligmosomoidea - Ornithostrongylidae - Ornithostrongylinae - *Ornithostrongylus* - Columbiform birds - Paraguay.

## INTRODUCTION

The genus *Ornithostrongylus*, a cosmopolitan parasite of birds, mainly Columbiformes, was erected by Travassos (1914) with the type species *Ornithostrongylus fariai*, a parasite of Columbidae in Brazil. Among Trichostrongylina collected in the Columbidae during field work of the Natural History Museum of Geneva in Paraguay from 1979 to 1986, two new species of the genus *Ornithostrongylus* were described from *Columbigallina talpacoti* (Durette-Desset & Vaucher, 2001). In *Leptoptila verreauxi*, the type species of the genus *O. fariai* Travassos, 1914 and *O. salobrensis* Travassos, 1941 have been identified and are redescribed herein. Up to now, the synlophe of these two species has not been studied nor have the morphological features of the female of *O. fariai*.

## MATERIAL AND METHODS

Nematodes were collected from the small intestine of their hosts and fixed in hot 4% formalin and subsequently sorted in the laboratory and stored in 70% ethanol. The specimens are deposited in the collections of the Muséum d'Histoire naturelle de Genève (MHNG) and in those of the Muséum national d'Histoire naturelle de Paris (MNHN). The nomenclature of the Strongylida above the family group follows that of Durette-Desset and Chabaud (1993). The synlophe was studied according to the method developed by Durette-Desset (1985). The nomenclature used to describe the synlophe and the caudal bursa are those of Durette-Desset & Vaucher (1999) and of Durette-Desset & Chabaud (1981) respectively.

In order to codify changes in the synlophe succinctly in descriptions, the numbers of dorsal and ventral ridges are presented in the format 6/6, the first numeral indicating the number of dorsal ridges, excluding the lateral alae and the second numeral indicating the number of ventral ridges. At their origin, the alae are indistinguishable from the ridges, then they increase in size towards posterior end and then taper again to become indistinguishable from the ridges. When the alae are indistinguishable, we treat them as ridges in the format.

## DESCRIPTIONS

### *Ornithostrongylus fariai* Travassos, 1914

Figs 1-28

#### MATERIAL STUDIED

In *Leptoptila verreauxi* (small intestine): Paraguay, Paraguari prov., 15 km East Cerrito (13/10/82), 4 males, a male posterior part, 1 female, a female posterior part: MHNG 35453 INVE; Paraguay, S-Maria (28/10/82), 5 males, a male posterior part, 3 females, a female anterior part: MNHN 884 KP; Paraguay, Bocqueron prov., Rio Pilcomayo at Pedro P. Pena (8/10/86), 2 males, 1 male in two parts, 2 female anterior parts, a female posterior part of female: MHNG 35454 INVE; Paraguay, Concepcion prov., Estancia Primavera (30/10/87), 4 males, a male posterior part, 2 females, 2 female anterior parts, 2 female posterior parts: MHNG 35455 INVE.

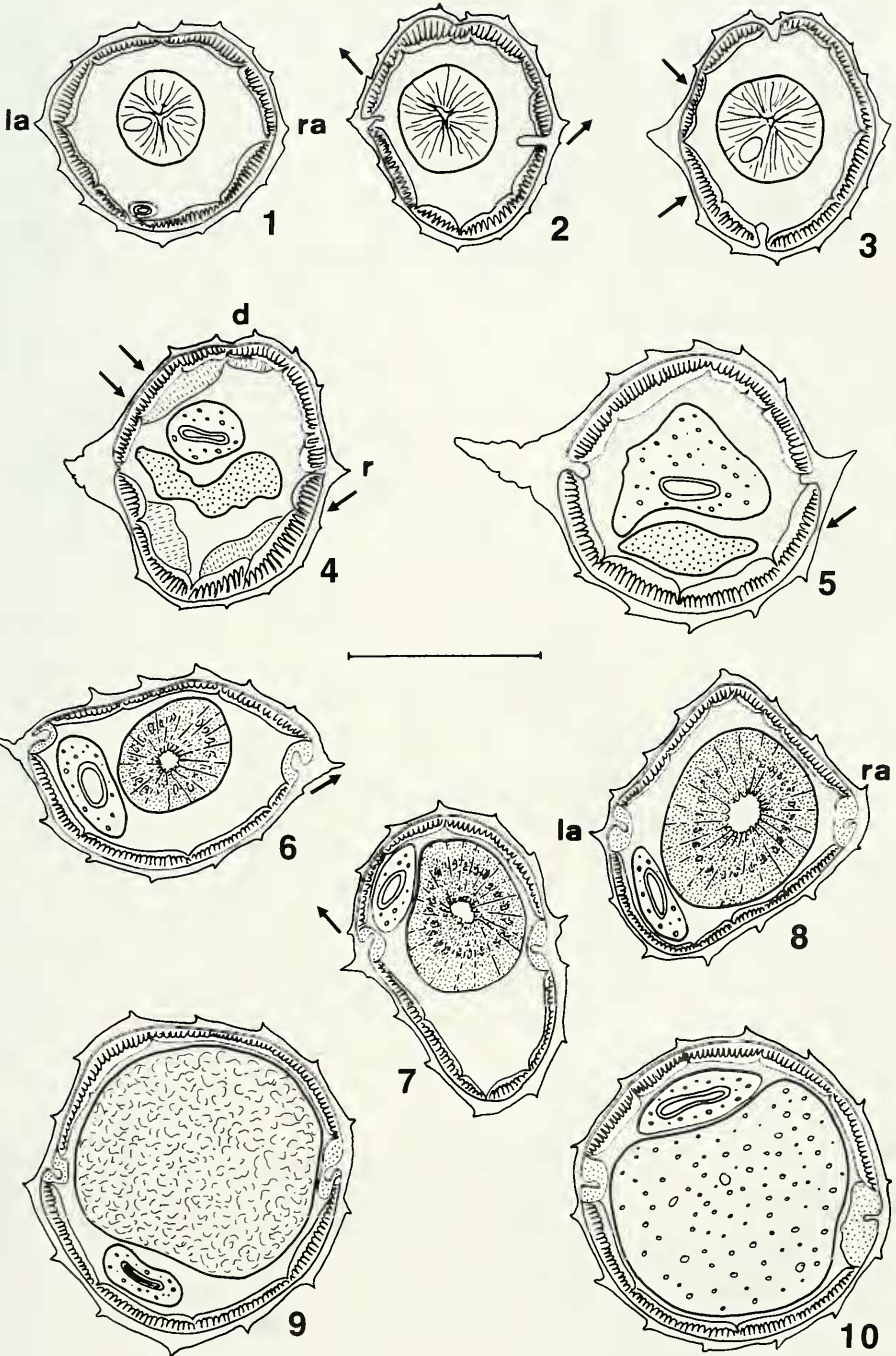
In three hosts (MNHN 884 KP, MHNG 35454 INVE, MHNG 35455 INVE), *O. fariai* is a coparasite of *O. salobrensis* Travassos, 1941.

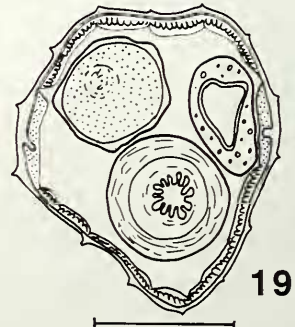
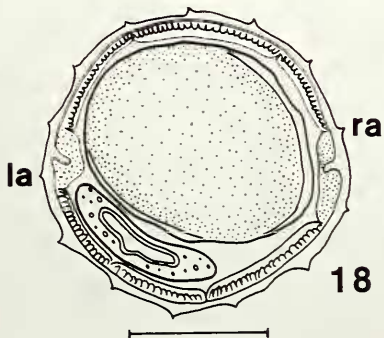
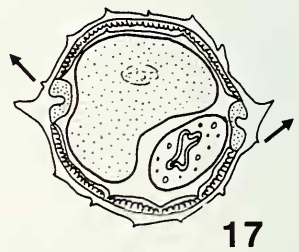
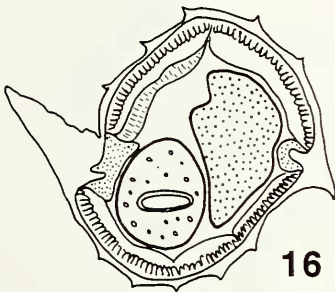
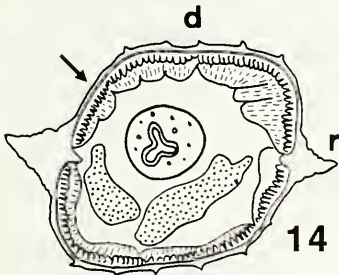
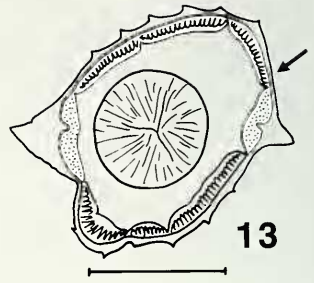
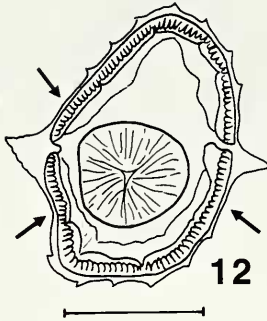
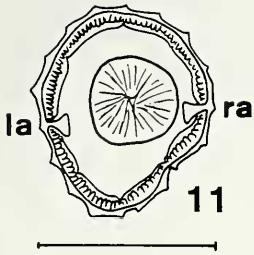
#### REDESCRIPTION

Small nematodes curved irregularly along the ventral or the dorsal side giving them a sinusoidal appearance or alternatively completely uncoiled except for the

#### FIGS 1-10

*Ornithostrongylus fariai* Travassos, 1914. Male, 8.8 mm long (male n°2, 884 KP). **1** - format 7/7, at 260  $\mu$ m from the apex (level of the excretory sinus); **2** - format 8/8, at 300  $\mu$ m from the apex; **3** - format 7/7, at 340  $\mu$ m from the apex; **4** - format 5/6, at 380  $\mu$ m from the apex (level of the oesophago-intestinal junction); **5** - format 5/5, at 1.1 mm from the apex, maximum wide of the alae; **6** - format 5/6, at 1.95 mm from the apex; **7** - format 6/6, at 2 mm from the apex (end of the first quarter of the body); **8** - format 7/7, at 2.8 mm from the apex. At this level, the alae have the same size as the other ridges; the left ala is therefore taken as equivalent of a ventral ridge and the right ala of a dorsal ridge; **9** - format 7/7, at 4.4 mm from the apex (mid-body); **10** - format 7/7, at 300  $\mu$ m anterior to the caudal bursa. Scale bar: 1-10: 50  $\mu$ m. Abbreviations: la: left ala; ra: right ala; d: dorsal side; r: right side. All the sections are orientated as in Fig. 4. The arrows directed towards the body indicate the disappearance of a ridge, arrows directed away from the body, the origin of a ridge.







anterior part. The deirids (Fig. 26) are situated at the level of the excretory pore or anterior to it (10-15  $\mu\text{m}$ ). The excretory glands are not visible in their anterior part.

Head (Fig. 24): The cephalic vesicle and a small dorsal-oesophageal tooth are present. In apical view, the rounded oral opening is surrounded by 4 cephalic papillae and 2 amphids. The two cycles of labial papillae were not observed.

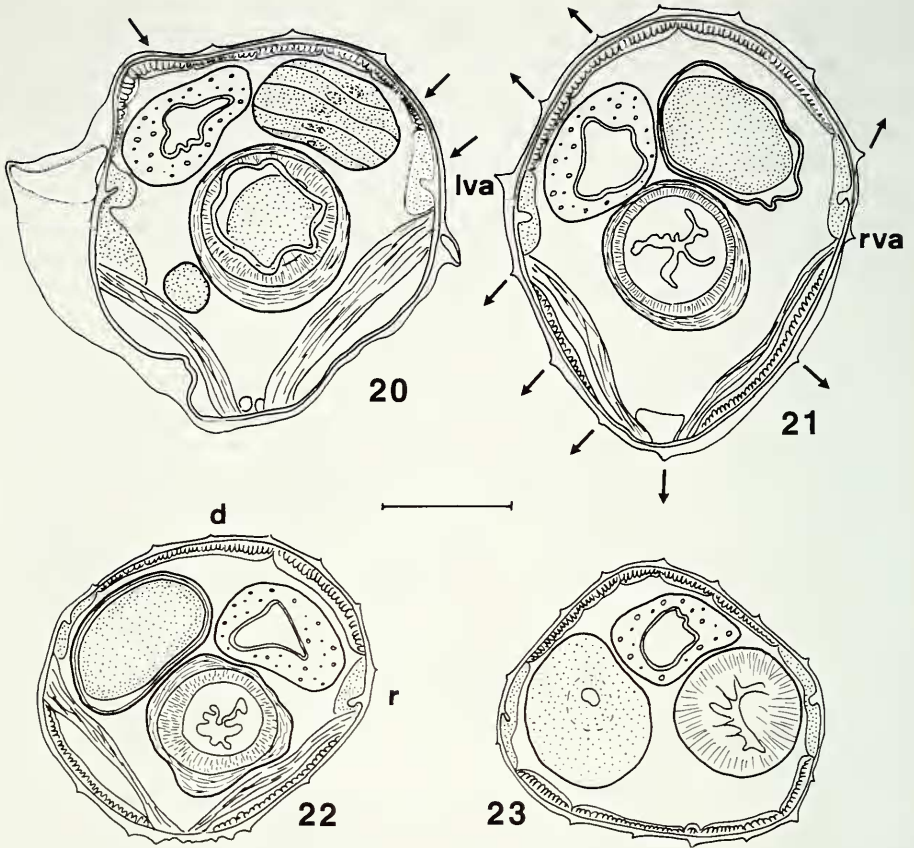
Synlophe (studied in one male and one female). In both sexes, the body bears uninterrupted cuticular ridges of which the number and pattern vary along the body. (Figs 1-10 for the male, 11-23 for the female). Two triangular lateral alae are present in both sexes and appear just posterior to the cephalic vesicle (Fig. 11). They disappear at the end of the anterior third of the body in both sexes (Fig. 75). The length of the alae is 2.7 mm in the male and 7.6 mm in the female. Before disappearing, the alae move slightly towards the ventral side for the left ala and the dorsal side for the right ala (Fig. 9). After disappearance of the alae, no ridge is present in front of the lateral fields (Figs 9-10, 18-23). The alae reach their maximum width at about 1.1 mm from the apex in the male (Fig. 5) and 1.4 mm in the female (Fig. 16). At this level and in section, the right ala is 12.5  $\mu\text{m}$  long by 12.5  $\mu\text{m}$  wide at its base in the male and 7.5  $\mu\text{m}$  long by 7.5  $\mu\text{m}$  wide at its base in the female; the left ala is 30  $\mu\text{m}$  long by 22  $\mu\text{m}$  wide at its base in the male and 21  $\mu\text{m}$  long by 15  $\mu\text{m}$  wide at its base in the female (Figs 5, 16). The alae are orientated perpendicularly to the body surface or slightly towards the dorsal side, except the right ala of the female which is orientated to the dorsal side between 980  $\mu\text{m}$  and 1.5 mm from the apex but this is probably due to an artefact. In the female, two alae are present anterior to the vulva. The left one is the better developed, triangular, 155  $\mu\text{m}$  long, and in section, 30  $\mu\text{m}$  long by 22  $\mu\text{m}$  wide at its base. The right one is 170  $\mu\text{m}$  long, and in section, 12  $\mu\text{m}$  long by 2  $\mu\text{m}$  wide (Fig. 20, 28).

In the male, 12 ridges (6 dorsal and 6 ventral; format 6/6) appear just posterior to the cephalic vesicle; 16 (8 dorsal, 8 ventral) plus alae (format 8/8) in the female (Fig. 11). In the anterior quarter of the body, the number of the cuticular ridges varies after the level of the section in both sexes: In the male, format 7/7 (level of the excretory sinus, Fig. 1), then successively format 8/8 (Fig. 2), 7/7 (Fig. 3), 6/6, 5/6 (level of the oesophago-intestinal junction, Fig. 4), 5/5 (Fig. 5), 5/6 (Fig. 6) and 6/6 (Fig. 7) at the end of the first quarter of the body. At the end of the third anterior part of the body, the alae are the same size as the other ridges and the format is 7/7 (Fig. 8). It remains

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#### FIGS 11-19

*Ornithostrongylus fariiai* Travassos, 1914. Female, 22.2 mm long (female n°3, 884 KP). **11** - format 8/8, just posterior to the cephalic vesicle; **12** - format 7/6, at 300  $\mu\text{m}$  from the apex (just posterior to the excretory pore); **13** - format 6/6, at 340  $\mu\text{m}$  from the apex; **14** - format 5/6, at 450  $\mu\text{m}$  from the apex (level of the oesophago-intestinal junction); **15** - format 5/5, at 530  $\mu\text{m}$  from the apex; **16** - format 5/5, at 1.4 mm from the apex, maximum wide of the alae; **17** - format 6/6, at 7.0 mm from the apex; **18** - format 7/7, at 7.7 mm from the apex. At this level, the alae have the same size as the other ridges; the left ala is therefore taken as equivalent of a ventral ridge and the right ala of a dorsal ridge; **19** - format 7/7, at 10.8 mm from the apex (mid-body). Scale bars: 11-19: 50  $\mu\text{m}$ . Abbreviations: la: left ala; ra: right ala; d: dorsal side; r: right side. All the sections are orientated as Figure 14. The arrows directed towards the body indicate the disappearance of a ridge, arrows directed away from the body, the origin of a ridge.

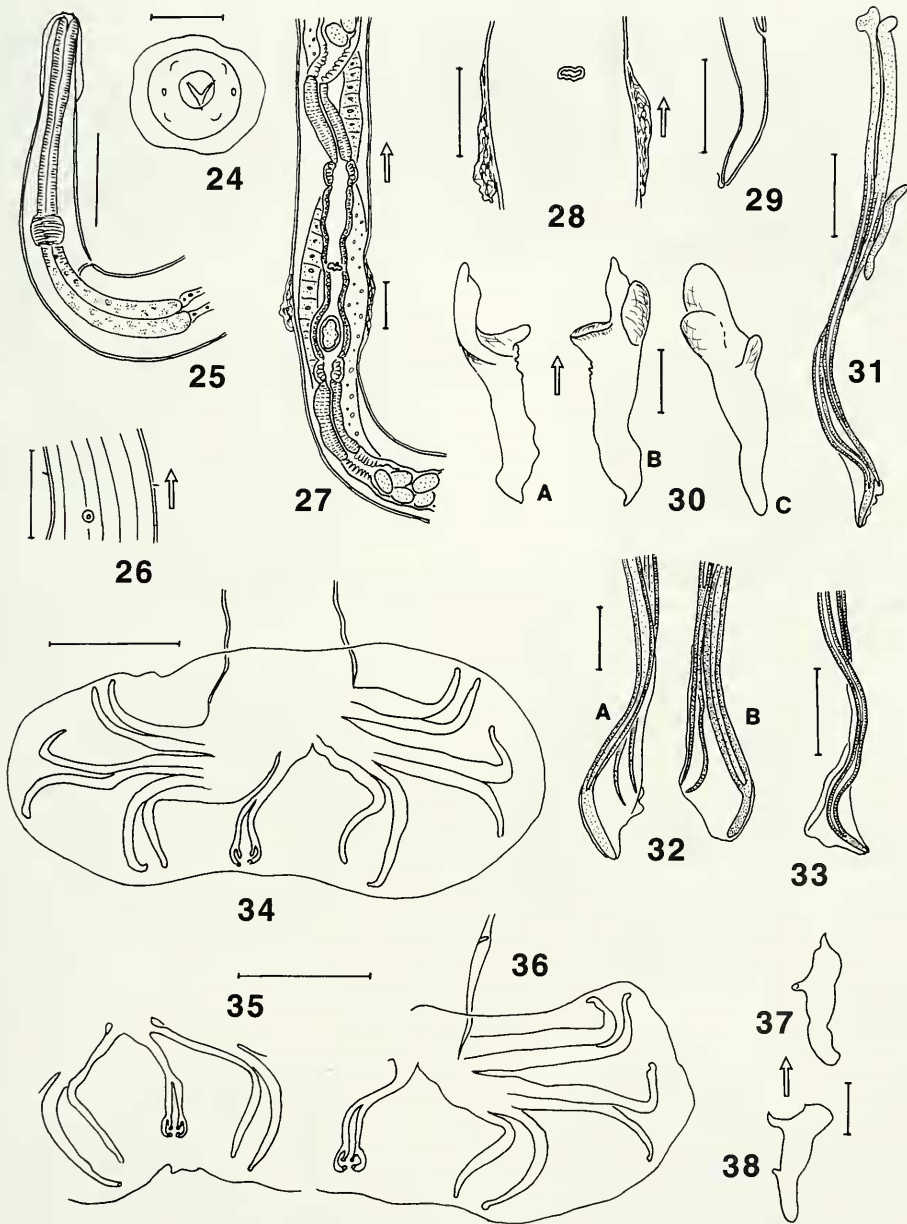


FIGS 20-23

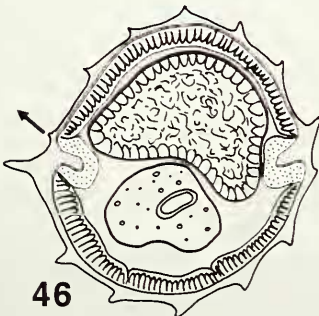
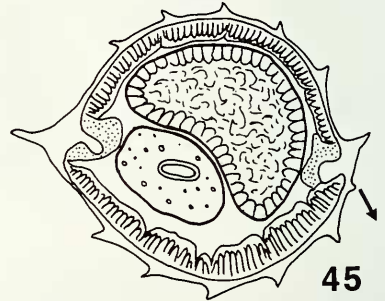
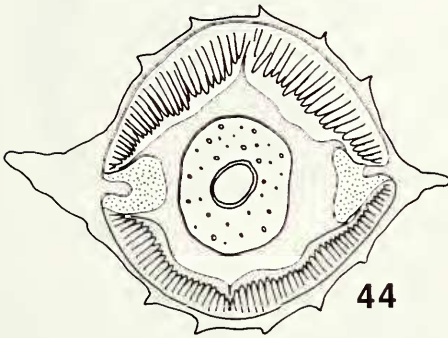
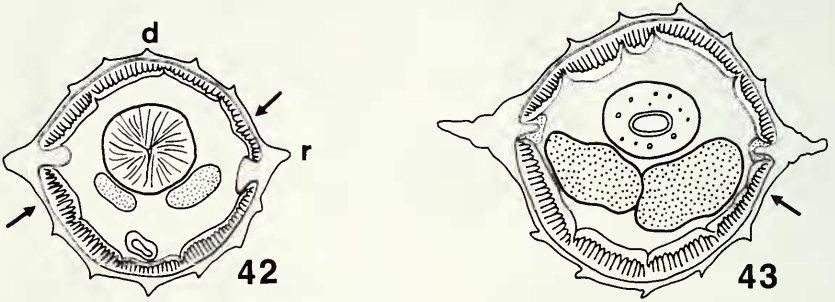
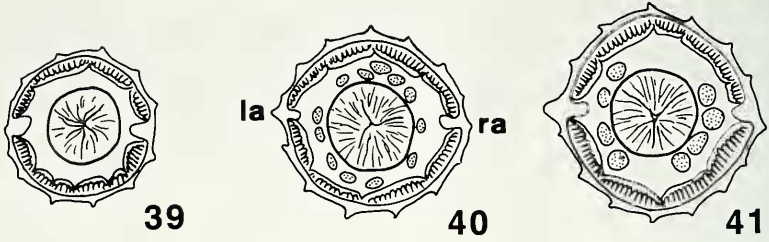
*Ornithostrongylus fariai* Travassos, 1914. Female, 22.2 mm long (female n° 3, 884 KP). **20** - format 3/0, just anterior to the vulva, presence of the vulvar alae; **21** - format 6/5, just posterior to the vulva; **22** - at the level of the posterior sphincter, 7 dorsal ridges, minute ventral ridges; **23** - format 7/7, at the level of the posterior infundibulum. Scale bar: 20-23: 50  $\mu$ m. Abbreviations: lva: left vulvar ala; rva: right vulvar ala; d: dorsal side; r: right side. All the sections are orientated as Figure 22. The arrows directed towards the body indicate the disappearance of a ridge, arrows directed away from the body, the origin of a ridge.

FIGS 24- 38

*Ornithostrongylus fariai* Travassos, 1914. **24** - female, head, apical view; **25** - Male, anterior extremity, right lateral view; **26** - male, detail of the excretory pore and the deirids, ventral view; **27** - female, ovejector, ventral view; **28** - female, detail of the vulva and the vulvar alae, ventral view; **29** - female, tail, right lateral view; **30** - male, gubernaculum, successively right (A), ventral (B) and left (C) views; **31** - male n°5, 35.455 INVE, spicules *in situ*, left lateral view; **32** - same male, spicules out of the body, tips, ventral (A) and dorsal (B) views; **33** - male n°1, 884



KP, spicules *in situ*, (only one tip of the left spicule is seen), right lateral view; **34** - male n° 5, 35453 INVE, caudal bursa, ventral view; **35** - male n°1, 35454 INVE, dorsal lobe of the caudal bursa, dorsal view; **36** - male n°3, 884 KP, left lobe of the caudal bursa (with left papilla 1), ventral view; **37**, **38** - male, gubernaculum, ventral view; **37** - male n°1, 884 KP, **38** - male n° 5, 35453 INVE. Scale bars: 24, 30, 32, 37, 38: 20  $\mu$ m; 26, 28, 31, 33-36: 50  $\mu$ m; 25, 27, 29: 100  $\mu$ m. The arrows indicate the anterior part of the body.





7/7 at mid-body (Fig. 9) and up to the caudal bursa (Fig. 10). In the female, format 7/7 (level of the nerve ring), 7/6 (level of the excretory pore, Fig. 12), then successively 6/6 (Fig. 13), 5/6 (level of the oesophago-intestinal junction, Fig. 14). At about 530  $\mu\text{m}$  from the apex, the format is 5/5 (Fig. 15) up to the level of the end of the anterior third of the body, then format 6/6 (Fig. 17). At 7.7 mm from the apex, the alae are the same size as the other ridges and the format 7/7 is obtained (Fig. 18). This format is present at mid-body (Fig. 19) and up to the level of the anterior branch of the vestibule. Just anterior to the vulva (Fig. 20), 4 dorsal ridges and all the ventral ridges disappear (format 3/0). Just posterior to the vulva (Fig. 21), 3 dorsal and 5 ventral ridges appear (format 6/5). Around the level of the posterior sphincter (Fig. 22), 2 more dorsal ridges and some minute ventral crests on the ventral side appear. Around the level of the posterior infundibulum (Fig. 23), format 7/7 is present and remains up to the level of the anus. The ridges are of equivalent size and orientated from right to left according to a sub-frontal axis, except in the vulvar region where they are orientated perpendicularly to the body.

The origin of new ridges and the disappearance of the ridges only affect the ridges adjacent to the lateral fields.

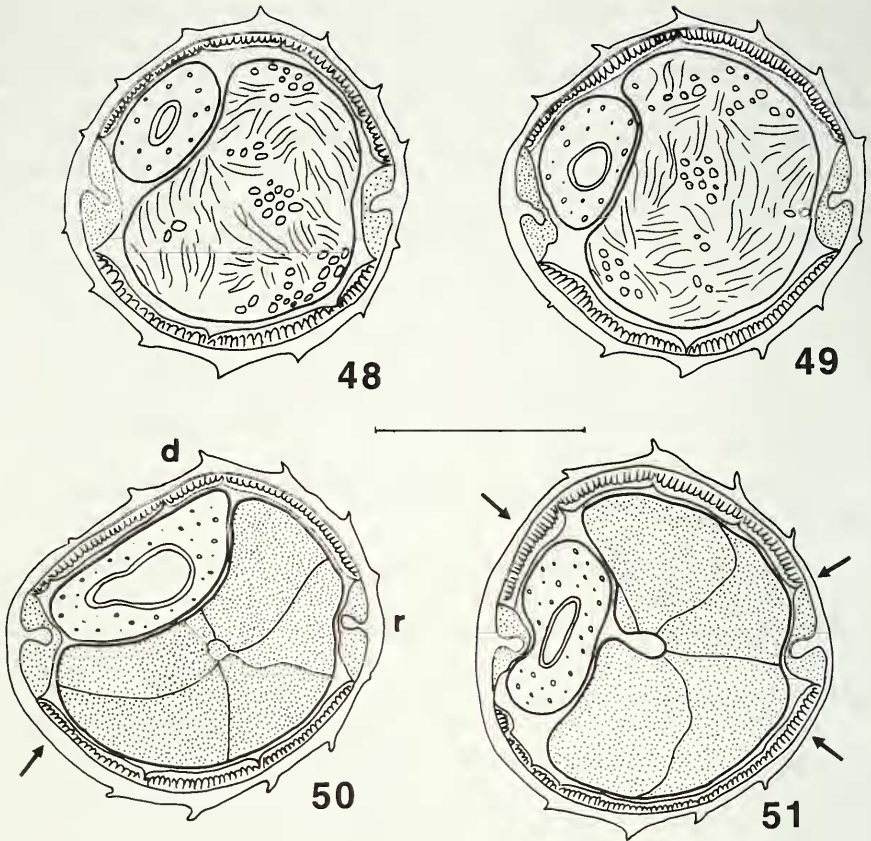
*Males:* 7.85 (6.2-10.6) mm long, 98 (90-100)  $\mu\text{m}$  wide at mid-body. Cephalic vesicle 74 (60-80)  $\mu\text{m}$  long and 38 (30-40)  $\mu\text{m}$  wide in median part. Nerve ring and excretory pore situated at 199 (180-205)  $\mu\text{m}$  and 260 (245-280)  $\mu\text{m}$  from apex, respectively. Deirids anterior to excretory pore (Fig. 26). Oesophagus, 400 (350-450)  $\mu\text{m}$  long, i.e. 5.1% of total body length (Fig. 25).

Pattern of caudal bursa type 2-3 with tendency to type 2-2-1 (rays 2,3 on one hand and 4,5 grouped together on the other hand, Fig. 34). Prebursal papillae present but rarely observed (Fig. 36). Rays 2 and 3 of equivalent length. Rays 2, 3 and 4 following parallel direction and are ventrally curved at extremities. Rays 5 joined to rays 4, divergent at extremities. Rays 6 curved, following parallel direction to rays 8, markedly separated from rays 5. Rays 8 arising on common trunk of rays 2 to 6 and joined to rays 6 for proximal half (Fig. 34) or at base of dorsal ray (Fig. 35). At its base, right ray 8 forms angle of  $10^\circ$  to  $30^\circ$  with dorsal ray (according to the specimens) and left ray 8, a right angle. Dorsal ray very thin, divided into two branches at mid-length. Each branch divided at extremity into two twigs, external branch (ray 9) curved and twice as long as internal, rectilinear branch (ray 10) (Fig. 35).

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FIGS 39-47

*Ornithostrongylus salobrensis* Travassos, 1941. Male, 8.6 mm long (male n°4, 885 KP). **39** - format 6/6, just posterior to the cephalic vesicle; **40** - format 7/7 and arising of the left ala, at 180  $\mu\text{m}$  from the apex (level of the nerve ring); **41** - format 6/7 and arising of the right ala, at 220  $\mu\text{m}$  from the apex; **42** - format 5/6, at 240  $\mu\text{m}$  from the apex (level of the excretory sinus); **43** - format 5/5, at 350  $\mu\text{m}$  from the apex (level of the oesophago-intestinal junction); **44** - format 5/5, at 790  $\mu\text{m}$  from the apex maximum wide of the alae; **45** - format 5/6, at 1.1 mm from the apex; **46** - format 6/6, at 1.15 mm from the apex; **47** - format 7/7, at 1.85 mm from the apex. At this level, the alae have the same size as the other ridges; the left ala is therefore taken as equivalent of a ventral ridge and the right ala of a dorsal ridge; Scale bar: 39-47: 50  $\mu\text{m}$ . Abbreviations: la: left ala; ra: right ala; d: dorsal side; r: right side. All the sections are orientated as Figure 42. The arrows directed towards the body indicate the disappearance of a ridge, arrows directed away from the body, the origin of a ridge.



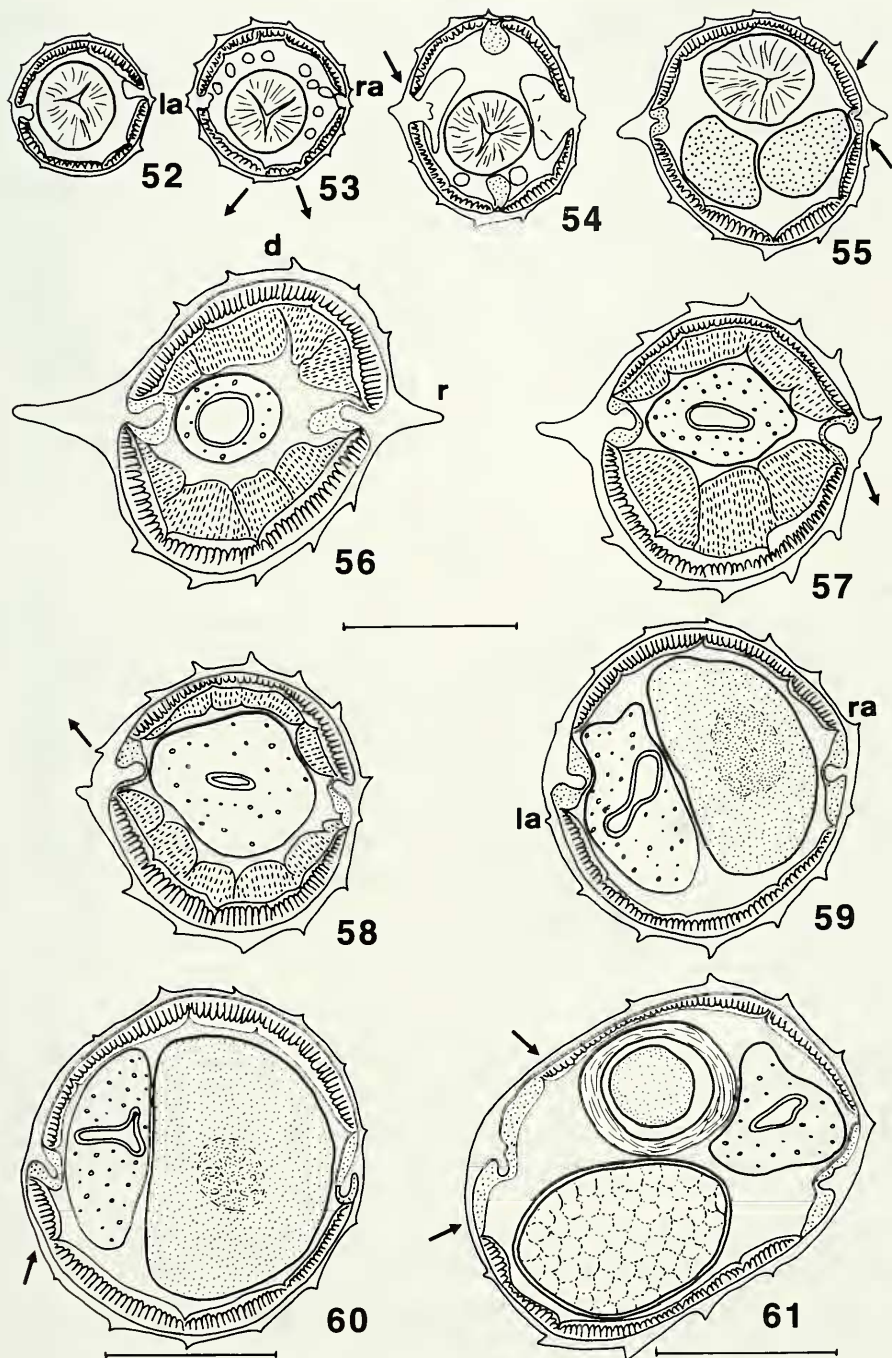
Figs 48-51

*Ornithostrongylus salobrensis* Travassos, 1941. Male, 8.6 mm long (male n°4, 885 KP). **48** - format 7/7, at 4.3 mm from the apex (mid-body); **49** - format 6/6, at 4.5 mm from the apex; **50** - format 6/5, at 5.3 mm from the apex; **51** - format 4/4, at 6.5 mm from the apex.

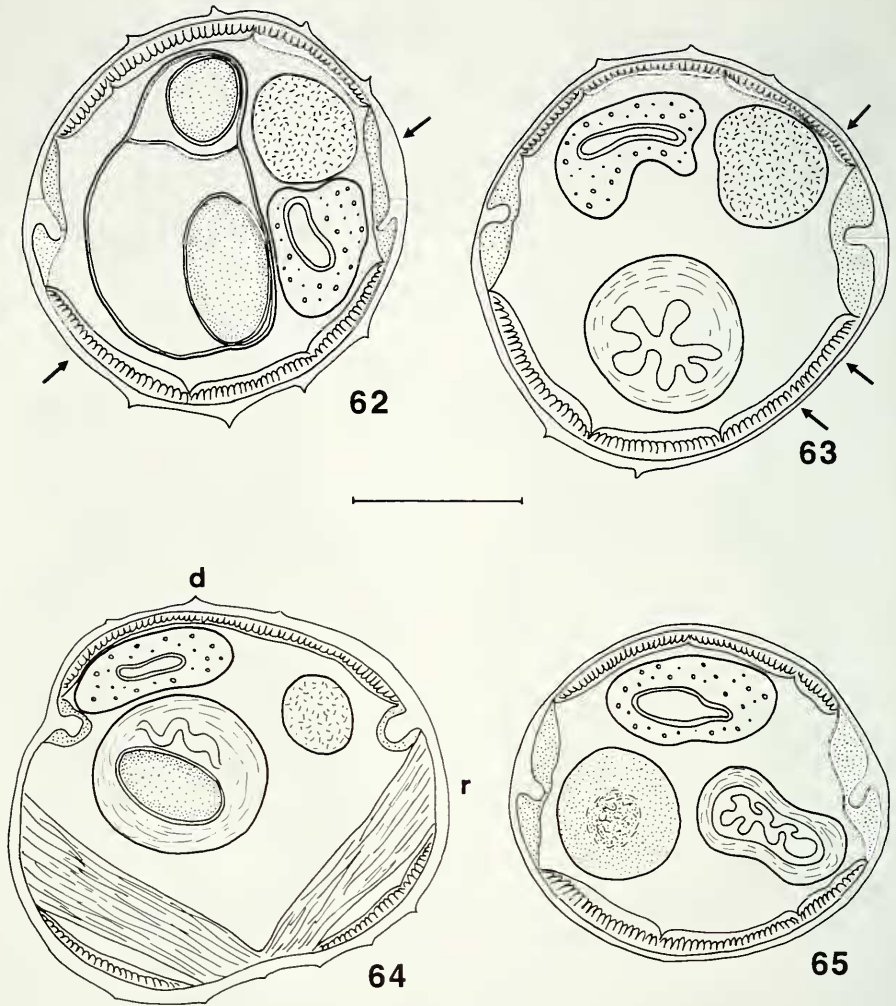
Scale bar: 48-50: 50  $\mu$ m. Abbreviations: d: dorsal side; r: right side. All the sections are orientated as Figure 50. The arrows directed towards the body indicate the disappearance of a ridge, arrows directed away from the body, the origin of a ridge.

Figs 52-61

*Ornithostrongylus salobrensis* Travassos, 1941. Female, 15 mm long (female n°1, 35456 INVE). **52** - format 6/4, just posterior to the cephalic vesicle; **53** - format 7/7 and arising of the alae, at 185  $\mu$ m from the apex, (level of the nerve ring); **54** - format 6/6, at 240  $\mu$ m from the apex (just posterior to the excretory pore); **55** - format 5/6, at 320  $\mu$ m from the apex; **56** - format 5/5, at 450  $\mu$ m from the apex (level of the oesophago-intestinal junction), maximum wide of the alae; **57** - format 5/6, at 700  $\mu$ m from the apex; **58** - format 6/6, at 1.3 mm from the apex; **59** - format 7/7, at 3.7 mm from the apex. At this level, the alae have the same size as the other ridges; the left ala is therefore taken as equivalent of a ventral ridge and the right ala of a dorsal ridge; **60** - format 6/6 at 5.7 mm from the apex; **61** - format 5/5, at 7.5 mm from the apex (mid-body). Scale bars: 52-61: 50  $\mu$ m. Abbreviations: la: left ala; ra: right ala; d: dorsal side; r: right side. All the sections are orientated as Figure 56. The arrows directed towards the body indicate the disappearance of a ridge, arrows directed away from the body, the origin of a ridge.







Figs 62-65

*Ornithostrongylus salobrensis* Travassos, 1941. Female, 15 mm long (female n°1, 35456 INVE). **62** - format 4/4, at 8 mm from the apex; **63** - format 3/2, at the level of the anterior branch of the vestibule; **64** - format 3/0, just anterior to the vulva; **65** - at 900  $\mu\text{m}$  from the tail, disappearance of all ridges. Scale bar: 62-65: 50  $\mu\text{m}$ . Abbreviations: d: dorsal side; r: right side. All the sections are orientated as Figure 64. The arrows directed towards the body indicate the disappearance of a ridge, arrows directed away from the body, the origin of a ridge.

Spicules asymmetrical, right spicule 319 (305- 350)  $\mu\text{m}$  long, left spicule 297 (280-325) long. Handle not enlarged. Tips of spicules enclosed in membrane (Figs 31-33). Right spicule ending in thick, blunt, curved tip. Left spicule ending in two sharp tips (Fig. 32 A, B). Gubernaculum with varying shapes according to specimens (Figs 30 A, B, C, 37, 38), not cruciform, left branch often short and rounded. Ratio spicule length/ body length 4.1%. Genital cone not observed.



*Females*: 21.2 (18.4-22.9) mm long and 110 (120-125)  $\mu\text{m}$  wide at mid-body. Cephalic vesicle 93 (90-100)  $\mu\text{m}$  long by 43 (40-50)  $\mu\text{m}$  wide in median part. Nerve ring and excretory pore situated at 207 (200-210) and 292 (285-310)  $\mu\text{m}$ , respectively. Oesophagus 437 (420-450)  $\mu\text{m}$ , 2.1 % of length of body.

Didelphic (Fig. 27). Vulva very discrete, situated 4.4 (4.2-4.5) mm from caudal extremity, at beginning of posterior quarter of body 20.6% (18.3-23.9) (Fig. 28). *Vagina vera* 65 (60-70)  $\mu\text{m}$  long, vestibule 360  $\mu\text{m}$  long divided into two parts, anterior part of same size or slightly longer than posterior part. Anterior branch: vestibule, 190 (170-200)  $\mu\text{m}$  long; sphincter, 48 (45-60)  $\mu\text{m}$  long by 50 (45-60)  $\mu\text{m}$  wide; infundibulum, 160 (150-170)  $\mu\text{m}$  long, uterine branch, 2.5 (1.9-2.9) mm long with more than 100 eggs. Posterior branch: vestibule, 170 (150-190)  $\mu\text{m}$  long; sphincter, 47 (40-60)  $\mu\text{m}$  long by 50 (40-60)  $\mu\text{m}$  wide; infundibulum, 150 (140-160)  $\mu\text{m}$  long, uterine branch, 2.6 (2.1-3.0) mm long with more than 100 eggs (Fig. 27). Eggs at morula stage 52 (50-55)  $\mu\text{m}$  long by 27 (25-30)  $\mu\text{m}$  wide. Tail 181 (165-195)  $\mu\text{m}$  long with caudal spine 26.7 (25-30)  $\mu\text{m}$  long (Fig. 29).

#### DISCUSSION

The specimens described above are identified as *Ornithostrongylus fariai* type species of the genus *Ornithostrongylus* described from *Leptoptila* spp. by Travassos (1914) in Brazil. This species is characterised by thin spicules with no clear differentiation between the handle and the blade. This feature is only shared by *O. almeidai* Travassos, 1937, a parasite of Tinamidae in Brazil. Both species are distinguished by the body length (five times longer in *O. fariai*), the origin of rays 8 on dorsal ray (at base of dorsal ray in *O. fariai*, more distally in *O. almeidai*) and the pattern of the dorsal ray beyond its division (symmetrical in *O. fariai*, strongly asymmetrical in *O. almeidai*).

As *O. fariai* is the type species of the genus, a detailed study of its synlophe along the body, variations of the pattern of the caudal bursa and the description of the female are of particular interest. The relevant features are listed below:

1) synlophe: presence of lateral alae in anterior third of body, orientated perpendicularly to it; synlophe sub-symmetrical in relation to frontal axis with cuticular ridges orientated from right to left; 14 cuticular ridges at mid-body; vulvar alae present; number of cuticular ridges and pattern of synlophe varying along body which is rare in the other Heligmosomoidea.

2) caudal bursa: pattern of type 2-3 with tendency to type 2-2-1, rays 8 arising from common trunk to rays 4 to 6 (Figs 34, 36) or at base of dorsal ray (Fig. 35).

3) spicules: thin with unenlarged handle; tips enclosed in common envelope; right spicule with single rounded tip, left spicules with two sharp tips.

4) gubernaculum: varying shape, never cross-shaped.

5) female: vulvar opening situated at three quarters of body length, ovejector with two symmetrical and opposite branches, uterine branches of equivalent length.

*Ornithostrongylus salobrensis* Travassos, 1941

Figs 39-74

#### MATERIAL STUDIED

In *Leptoptila verreauxi* (small intestine): Paraguay, Paraguari prov., 15 km East of Cerrito (13/10/82), 2 males, 3 females: MHNG 35456 INVE; Paraguay, Bocqueron prov., Rio

Pilcomayo at Pedro P. Pena (8/10/86), 1 male 885 KP; 1 male 886 KP; Paraguay, Concepcion prov., E. Primavera (30/10/87), a male posterior part MHNG 35457 INVE.

Except in host 886 KP, *O. salobrensis* is a coparasite of *O. fariai*.

#### REDESCRIPTION

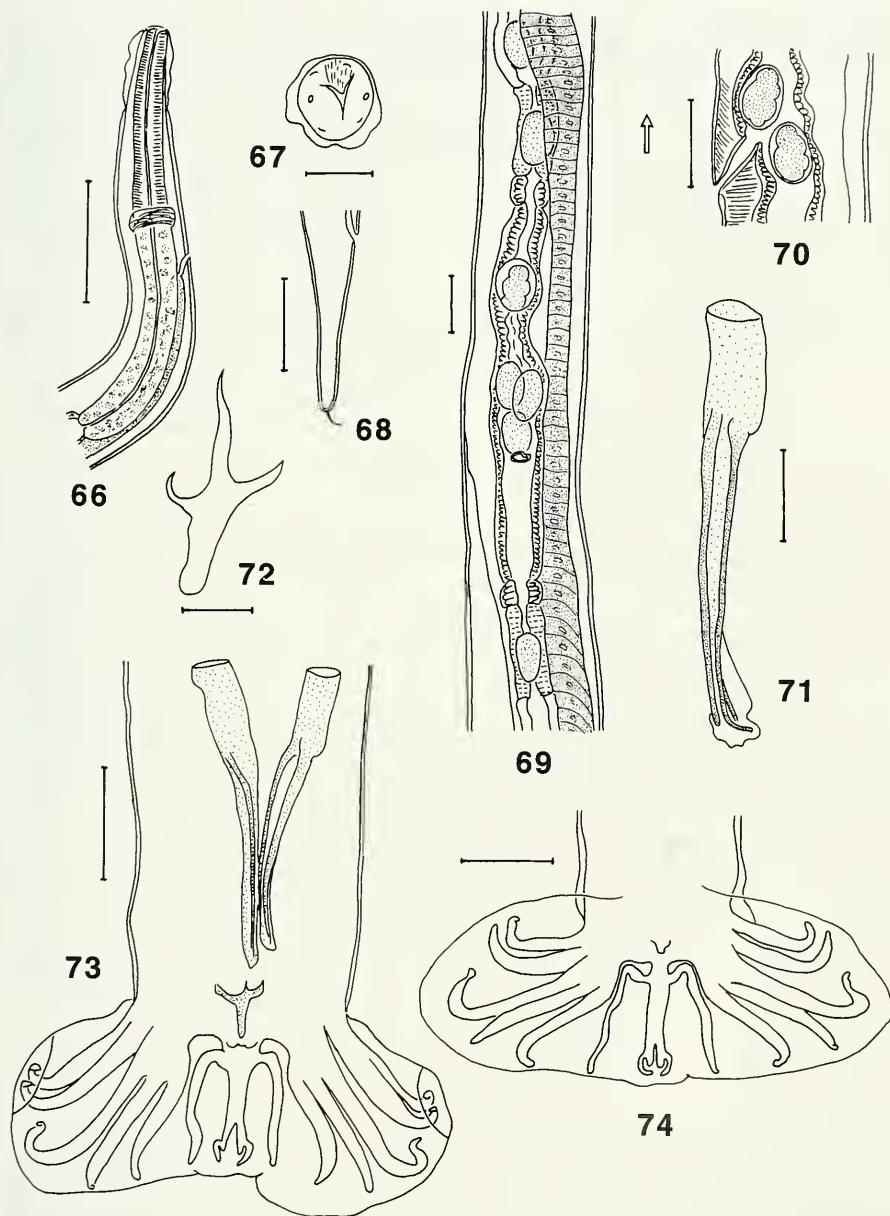
Small nematodes curved irregularly along the ventral or the dorsal side giving them a sinusoidal appearance or alternatively completely uncoiled except for the anterior part. The deirids, observed only in the 2 females, are situated at the level of the excretory pore or anterior to it (40  $\mu\text{m}$ ). The excretory glands are not visible in their anterior part.

Head (Fig. 67): the cephalic vesicle and a small dorso-oesophageal tooth are present. In apical view, the rounded oral opening is surrounded by 4 cephalic papillae and 2 amphids. The two cycles of the labial papillae were not observed.

Synlophe: (studied in one male and one female). In both sexes, the body bears uninterrupted cuticular ridges of which the number and the pattern vary all along the body (Figs 39-51 for male, 52-65 for female). Two triangular lateral alae are present in both sexes. In the male, the alae appear at different levels: at the level of the nerve ring for the left ala (180  $\mu\text{m}$  from the apex, Fig. 40) and 40  $\mu\text{m}$  posteriorly for the right ala (Fig. 41). In the female, the alae appear at the same level, at the level of the nerve ring (185  $\mu\text{m}$  from the apex, Fig. 53). The alae disappear 300  $\mu\text{m}$  anterior to the first quarter of the body in the male (Fig. 47) and at the end of the first quarter in the female (Fig. 59). The length of the alae is 1.67 mm (left ala), 1.63 mm (right ala) in the male and 3.56 mm in the female. Before disappearing, the alae move slightly towards the ventral side for the left ala and the dorsal side for the right ala. After the disappearance of the alae, no ridge is present in front of the lateral fields (Figs 47-51, 59-65). The alae reach their maximum width at about 790  $\mu\text{m}$  from the apex in the male (Fig. 44) and 450  $\mu\text{m}$  in the female (Fig. 56). At this level and in section, the right ala is 14  $\mu\text{m}$  long by 14  $\mu\text{m}$  wide at its base in the male and 14  $\mu\text{m}$  long by 10  $\mu\text{m}$  wide at its base in the female; the left ala is 28  $\mu\text{m}$  long by 27  $\mu\text{m}$  wide at its base in the male and 28  $\mu\text{m}$  long by 22  $\mu\text{m}$  wide at its base in the female. The alae are orientated perpendicularly to the body surface.

In the male, 12 cuticular ridges (6 dorsal, 6 ventral, format 6/6) appear just posterior to the cephalic vesicle (Fig. 39), 12 (6 dorsal, 4 ventral, format 6/4) in the female (Fig. 52). In the anterior quarter of the body, the number of the cuticular ridges varies depending upon the level of the section: In the male, format 6/7 (at the level of the nerve ring, Fig. 41), 5/6 (at the level of the excretory sinus, Fig. 42), 5/5 (at the level of the oesophago-intestinal junction, Fig. 43), 5/6 at about 1.1 mm from the apex (Fig. 45), then 6/6 at about 1.15 mm from the apex (Fig. 46). Format 7/7 appears when the alae are the same size as the other ridges (at the end of the first quarter of the body, Fig. 47) and is present at mid-body (4.3 mm from the apex, Fig. 48) then 6/6 at 4.5 mm from the apex (Fig. 49). About 1 mm more posteriorly, format 6/5 appears (Fig. 50) then 4/4 at about 5.9 mm from the apex (Fig. 51). The 8 ridges remaining disappear at about 200  $\mu\text{m}$  anterior to the caudal bursa.

In the female, format 7/7 (at the level of the nerve ring, Fig. 53), 6/6 (level of the excretory pore, Fig. 54), 5/6 at 320  $\mu\text{m}$  from the apex (Fig. 55), 5/5 (just before the level of the oesophago-intestinal junction, Fig. 56). At about 700  $\mu\text{m}$  from the apex,



FIGS 66-74

*Ornithostrongylus salobrensis* Travassos, 1941. 66 - male, anterior extremity, right lateral view; 67-70 - female; 67 - head, apical view; 68 - tail, right lateral view; 69 - ovejector, ventral view; 70 - detail of the vulvar musculature, left lateral view; 71-74 - male; 71 - dissected left spicule, ventral view; 72 - gubernaculum, ventral view; 73 - caudal bursa, ventral view; 74 - other male, caudal bursa, ventral view. Scale bars: 67, 72: 20 μm; 70, 71: 50 μm; 66, 68, 69, 73, 74: 100 μm. The arrow indicates the anterior part of the body.

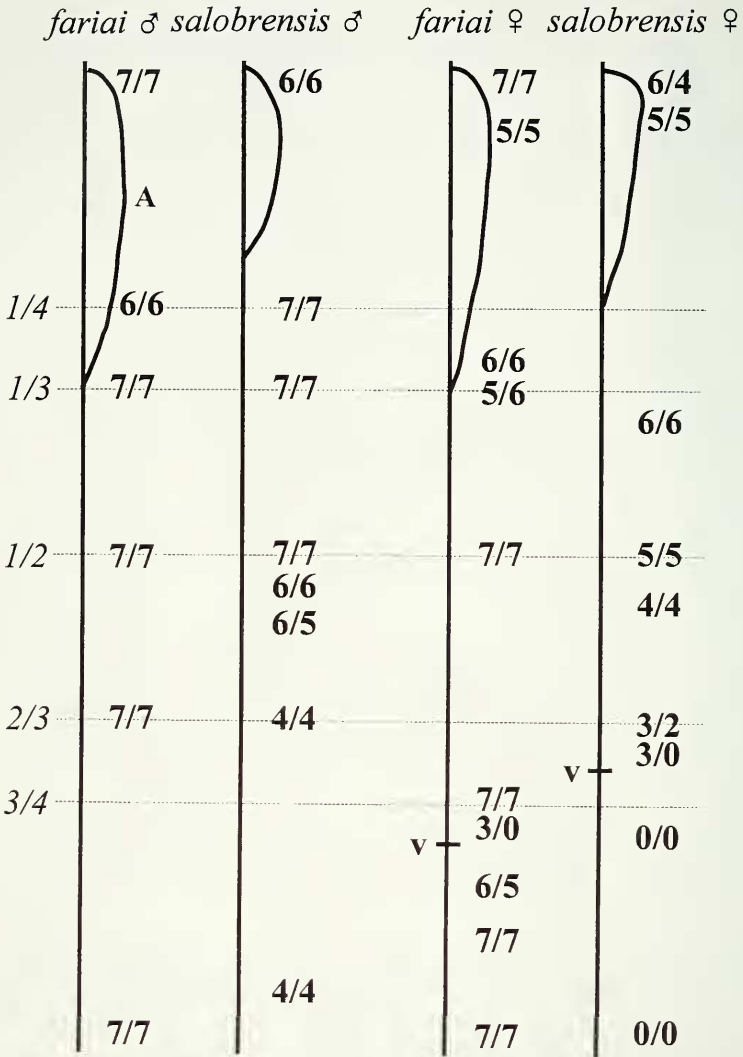


FIG. 75

Diagram of the number and the pattern of the cuticular ridges all along the body, in two species of the genus *Ornithostrongylus*, *O. fariai* and *O. salobrensis*. On these schemes, the top represents the apex and the bottom the level of the caudal bursa in males and the end of the tail in females. The shape of the lateral alae is indicated only on the right side. The number of the cuticular ridges (7/7, dorsal/ventral, etc.) is indicated according to the level of the sections along the body, at the anterior quarter (1/4), at the anterior third (1/3), at mid-body (1/2), at the two-thirds (2/3), at the third fourth (3/4) and at vulvar level (v). The alae (A) are illustrated according to their length and their width. In *O. fariai*, the alae are present in the anterior third of the body, in *O. salobrensis*, only in the anterior quarter. In *O. fariai*, the number of the cuticular ridges is 7/7 at mid-body and up to the caudal bursa and the vulvar level. In *O. salobrensis*, the format is 7/7 at mid-body in the male, 5/5 in the female. In the posterior third of the body, the format is 4/4 in the male and there is no ridges in the female.



the format is 5/6 (Fig. 57) then 6/6 at about 1.3 mm from the apex (Fig. 58). Format 7/7 appears when the alae are the same size as the other ridges (at 3.7 mm from the apex, Fig. 59) and remains up to the beginning of the second quarter of the body. At about 5.7 mm from the apex, the format is 6/6 (Fig. 60) then format 5/5 (7.8 mm from the apex) at mid-body (Fig. 61). Just after mid-body, the format is 4/4 up to the end of the third quarter (Fig. 62). At the level of the anterior infundibulum, the format is 3/3, then format 3/2, just anterior to the vulva (Fig. 63). At the level of the vulva, there are 3 dorsal ridges and 6 minute ventral crests (Fig. 64). All the ridges disappear at about 120  $\mu\text{m}$  posterior to the vulva (Fig. 65).

The ridges are of equivalent size except in the median part of the female where the ventral ridges are slightly more developed than the dorsal ridges. The ridges are orientated from right to left with a sub-frontal axis.

The origin of new ridges and the disappearance of the ridges only affect the ridges adjacent to the lateral fields.

*Males:* 8.1 (7.4-8.6) mm long, 93 (90-100)  $\mu\text{m}$  wide at mid-body. Cephalic vesicle 76 (70-90)  $\mu\text{m}$  long by 38 (35-40)  $\mu\text{m}$  wide in median part. Nerve ring and excretory pore situated at 163 (150-180)  $\mu\text{m}$  and 220 (200-240)  $\mu\text{m}$  from apex, respectively (Fig. 66). Deirids not observed. Oesophagus, 337 (310-350)  $\mu\text{m}$ , 4.1% of total body length. Pattern of caudal bursa type 2-3 (Figs 73, 74). Prebursal papillae not observed. Rays 2 and 3 of equivalent length. Rays 2, 3 and 4 following parallel direction, ventrally curved at extremities. Rays 4 best developed. Rays 5 joined to rays 4 except at extremities or slightly separated from them. Extremities of rays 6 very remote from rays 8. Rays 8 arising perpendicularly to dorsal ray, then turning abruptly posteriorly (shoulder-shaped) and following approximately parallel trajectory to that of dorsal ray. Rays 8 and dorsal ray of equivalent size. Dorsal ray divided into two branches at distal third. Each branch divided at extremity into two twigs, external branch (ray 9) curved and twice as long as internal, rectilinear (ray 10). Symmetrical, subequal spicules, 233 (220-250) long (Figs 71, 73). Thick rectangular handle, one third of spicule length. Blade divided into three branches each ending in sharp point. Tips enclosed in membrane. Cross-shaped gubernaculum, 54 (50-62) long, 42 (40-45) maximum width (Fig. 72). Very small genital cone (Figs 73, 74). Ratio of spicule length/body length 2.88%.

*Females:* 15, 14.8 mm long and 105, 120  $\mu\text{m}$  wide at mid-body. Cephalic vesicle 80, 70  $\mu\text{m}$  long by 40, 40 wide in median part. Nerve ring, excretory pore and deirids situated at 185, 175; 230, 220; 190, 220  $\mu\text{m}$  from apex, respectively. Oesophagus 370, 360  $\mu\text{m}$  long, 2.4% of total body length.

Didelphic (Fig. 69). Vulvar opening discrete, situated at 4.2, 3.3 mm from caudal extremity, at beginning of posterior quarter of body (28%, 22%); strong vulvar musculature (Figs 64, 70). *Vagina vera* 50, 50  $\mu\text{m}$  divided vestibule 425, 300  $\mu\text{m}$  long into two asymmetrical parts. Anterior branch: vestibule, 290, 150  $\mu\text{m}$  long, sphincter, 30, 40  $\mu\text{m}$  long and 50, 45  $\mu\text{m}$  wide, infundibulum, 110, 110  $\mu\text{m}$  long, uterine branch, 2.9, 1.7 mm long with 227 eggs. Posterior branch: vestibule, 135, 150  $\mu\text{m}$ , sphincter, 30, 40,  $\mu\text{m}$  long and 40, 45  $\mu\text{m}$  wide, infundibulum, 110, 120,  $\mu\text{m}$  long, uterine branch, 1.1, 1.8 mm long with 151 eggs. Eggs at morula stage 60 by 40, 50 by 30  $\mu\text{m}$  long. Tail (Fig. 68) 150, 200  $\mu\text{m}$  long with caudal spine, 22  $\mu\text{m}$  long (broken).

## DISCUSSION

The specimens described above are identified as *Ornithostrongylus salobrensis* a parasite of *Leptoptila verreauxi* described by Travassos (1941) in Brazil. Among the members of this genus, *O. salobrensis* is the only species which has a unique pattern of the dorsal lobe with shoulder-shaped rays 8. In the other species of *Ornithostrongylus* with rays 8 arising perpendicularly to the dorsal ray, rays 8 form an arc. The synophe has a similar pattern as that of *O. fariai*. However the alae are shorter, present only in the anterior quarter of the body; in the female the number of cuticular ridges is 5/5 at mid-body; in the posterior third of the body the number of cuticular ridges is 4/4 in the male and there are no ridges in females (Fig. 75).

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